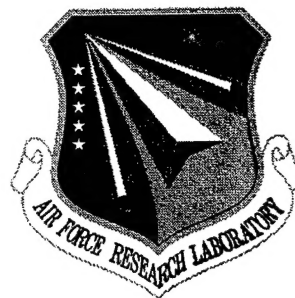


**AFRL-IF-RS-TR-1999-232**  
**Final Technical Report**  
**October 1999**



## **TI-960 DEPOT DIGITAL MODULE TEST STATION PROTOTYPE ENHANCEMENTS**

**Synectics Corporation**

**Cheryl Haritatos and Fred Harrison**

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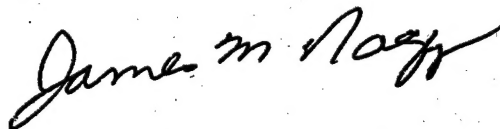
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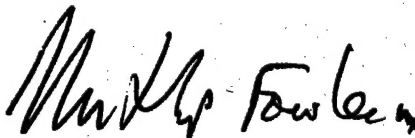
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## **ABSTRACT**

This report summarizes the results of a 12-month program to:

1. Jointly develop with OO-ALC an upgraded disk drive for the TI-960 DDMTS that would also replace the system's magnetic tape.
2. Provide upgraded disks for all seven DDMTS stations at OO-ALC.
3. Perform a study to determine the best method for providing a VXI-based replacement for the TI-960 DDMTS.

## 1.0 FORWARD

The effort undertaken as a part of this subcontract was designed to improve the reliability and maintainability of the F-16 DDMTS Test Station. The first part of this activity involved the development and installation of stations at OO-ALC to upgrade Model 1265 disk subsystems. The second part involved an in-depth study of the characteristics of the DDMTS to determine the best approach to replace the station using state-of-the-art VXI technology.

## 2.0 SYMBOLS, ABBREVIATIONS, AND ACRONYMS

|         |   |
|---------|---|
| 1265    | C&H Technologies Model Number of Disk Drive                             |
| 979     | Texas Instruments Model Numbers of Magnetic Tape Drive                  |
| ATE     | Automatic Test Equipment  |
| ATS-960 | Texas Instruments Model Numbers of ATE that are used for DDMTS          |
| CD      | Compact Disk  |
| DDMTS   | Depot Digital Module Test Station                                       |
| DMAC    | Direct Memory Access Channel  |
| DOS     | Disk Operating System   |
| GB      | Giga bytes  |
| I/F     | Interface   |
| I/O     | Input-Output  |
| MB      | Mega bytes  |
| PC      | Personal Computer   |
| RAM     | Random Access Memory  |
| SCSI    | Small Computer System Interface   |
| UPS     | Uninterruptable Power Supply  |
| USB     | Universal Serial Bus  |
| VME     | <u>V</u> ersatile <u>M</u> odular <u>E</u> uropean                      |
| VXI     | <u>V</u> ME with <u>e</u> <u>X</u> tensions for <u>I</u> nstrumentation |

## **3.0 DEVELOPMENT OF REPLACEMENT DISK DRIVE**

### **3.1 SUMMARY**

C&H Technologies, Inc. developed a replacement 1265 disk drive during the twelve-month program. Support software developed by OO-ALC, TISA was integrated with the disk drive, and the unit was successfully demonstrated to operate as intended. A total of seven drives have been furnished to OO-ALC as required by the subcontract.

### **3.2 INTRODUCTION**

C&H Technologies had developed its Model 1265 disk drives for use with the ATS-960 test system. Early versions of this drive were already installed on the DDMTS at Hill AFB. It was desired that these be upgraded to newer technology and modified to replace the TI 979 magnetic tape unit as well.

### **3.3 OBJECTIVES AND GOALS**

The objectives and goals of this effort included the following.

- ☐ Develop an upgraded 1265 disk hardware set.
- ☐ Integrate Hill software to replace 979 tape drive.
- ☐ Provide seven upgraded units.

### **3.4 RESULTS AND DISCUSSION**

#### **3.4.1. CHRONOLOGY**

The chronology of this portion of the project follows.



***01 May 1998 to 01 June 1998***

C&H reviewed the proposed equipment configuration of the Model 1265 required to replace the functions provided by the Texas Instruments Model 979A magnetic tape drive. The configuration had originally been developed several years earlier and had gone through periodic upgrades with the availability of new PC technologies.

***01 June 1998 to 10 July 1998***

Hill AFB personnel reviewed the list of equipment and inquired about the price and delivery of items on the list.

***13 July 1998***

Technical Interchange Meeting (TIM) #1 – C&H received approval for the equipment configuration list and moved ahead with purchasing the quantity required for two prototype units.

***27 July 1998***

Purchasing for the prototype units was completed and availability for the six production units was assured.

***01 September 1998 to 13 October 1998***

Integrated and tested the prototype units using C&H version of the disk emulation software. The speed of the new processor required modification to the software that had been originally written for an XT environment and later modified for the AT class machine. The prototypes operated successfully under DOS 6.22.

***14 October 1998***

C&H shipped one Model 1265MT prototype unit (S/N: 126) to Hill AFB.

***20 October 1998 to 23 October 1998***

The prototype unit on Software Station #1 was installed. The prototype was operational under DOS 6.22, DOS 7.0, and Windows 95B (with networking capability), using the C&H version of the Diablo disk emulation software. OO-ALC and C&H agreed that this configuration would satisfy the requirements of the contract, and C&H could build the remaining units with the same PC hardware delivered on the prototype.

***10 November 1998***

OO-ALC agreed with C&H that the decisions reached during the prototype installation in October would become the technical items for TIM #2. Therefore, no formal meeting was scheduled and the results of the installation were published.

***17 December 1998***

C&H shipped six Model 1265MT production units (S/Ns 128 through 133) to Hill AFB.

***18 January 1999 to 27 January 1999***

TIM #3 consisted of several meetings attended by personnel from TISAC, LARPA, LMTAS, and C&H. The following items were goals for the remainder of the C&H installation trip.

1. Define the configuration of the DDMTS Self Test ATLAS Disk to incorporate changes that had occurred since the previous release at General Dynamics.
2. Increase the number of usable disk images from 55 to 91.
3. Move the system disk images for Single and Dual disk operation from images 54 and 55 to images 90 and 91.
4. Add a hardware reset path in DOS Mode during boot up to initialize disk-related hardware before starting up in Windows Mode.
5. Add a UPS to the configuration to ensure a graceful shutdown and restart in the case of a loss of power.
6. Create a baseline set of program disk images to reside on the network to ensure configuration control between systems.
7. Install one production disk drive on System #4, which is used 2 shifts per day, to test the new disk system in a production environment.
8. Install disk drive on Software System #2.

All items were accomplished.

***01 February 1999 to Present***

TISAC personnel installed remaining Model 1265MT production units as required and as UPSs have been acquired to preserve configuration control.

**Table 1      Final Disk Configuration**

|     |   |
|-----|---|
| 1.  | Chassis (similar to existing, with newer PS and filtering system)   |
| 2.  | Pentium II Single Board Computer (333 MHz, 64MB RAM, SVGA, 2 serial ports, 2 USB 1.0 ports, Ethernet, Ultra Wide SCSI, IDE) |
| 3.  | Passive Backplane   |
| 4.  | Hard Drive – 4 GB IDE   |
| 5.  | Floppy Drive – 1.44 MB (only on prototype; not needed on production units)  |
| 6.  | DOS 6.22  |
| 7.  | Windows 98 (Windows NT will be a future upgrade)  |
| 8.  | CD Writer (only on prototype; production units will be downloaded via the network)  |
| 9.  | Digital I/O (PCI-20087W-1)  |
| 10. | DMAC I/F (C&H 11000004-0001)  |
| 11. | PC I/F (C&H 11000007-0001)  |
| 12. | Control Panel (C&H 11026053-0001)   |
| 13. | Buffer Board (C&H 11026124-0001)  |
| 14. | Control Panel Cables (C&H 11026088-0001) Qty 2  |
| 15. | Model 1265 I/F Cable (C&H 11000026-0001)  |
| 16. | UPS – American Power Conversions, BP280S (USAF Add-on)  |

### **3.5 CONCLUSIONS**

All goals and objectives were met and all equipment successfully delivered.

## **4.0 DDMTS VXI REPLACEMENT STUDY**

### **4.1 SUMMARY**

A report was submitted that addressed the issue of replacing the F16 DDMTS with VXI. The report included background on the ATS-960 on which the DDMTS is based. Attention was given to the architecture of the ATS-960 as it has an extremely strong influence on the methodologies and equipment to be used for replacement of the original test set.

A discussion of prior technology insertion programs was presented as this provided information on the projects that C&H has completed for the USAF and other customers. These projects have given the company an insight into the process of equipment support and replication that will only be found with a few vendors.

The balance of the report took the reader through the process of hardware requirements definition, the process of replacement equipment selection, and the configuration of this equipment into a viable system. In this process, consideration was given to not only equipment specifications, but also the systemic characteristics that effect the overall operation of any given Test Program Set.

### **4.2 INTRODUCTION**

The purpose of this effort was an engineering study to determine potential methods for utilizing existing or C&H development VXI technology that could be used to further upgrade the TI-960 DDMTS used by the Air Force for the F-16 Depot. The objective is to provide for better long-term support of the equipment. This effort involved numerous trade-off studies for instrumentation selection, functional analysis of the DDMTS to determine the best way to re-implement the station using newer technology, and trade-offs between hardware and software as necessary.

### **4.3. GOALS**

The goals of the study included:

- ☐ Performing an in-depth analysis of the ATS-960 to determine the key specifications needed to be met by any suite of new equipment in order to replicate the test capabilities of the DDMTS.

- ☐ Determining the key specifications of each unit within the tester that must be met in order to operate the TPSs with the same results as with the TI tester.
- ☐ Identifying new VXI-based equipment, which would satisfy the requirements.
- ☐ Proposing a method for combining this new equipment and alternate new approaches into a configuration, which may be used to replace the DDMTS.
- ☐ Providing a preliminary estimate of both recurring and non-recurring costs associated with development and implementation of the proposed system.

#### **4.4. RESULTS AND DISCUSSION**

The study provided an overview of some of the significant elements that would be involved in recurring and non-recurring labor as well as recurring materials. It also provided an indication of a preliminary schedule.

##### **4.4.1. NON-RECURRING ELEMENTS**

The non-recurring charges associated with the development of a VXI replacement for the DDMTS included charges associated with design engineering, development engineering, prototyping materials, and prototyping test costs. As part of the prototype and development, a complete system would be required. Therefore, the recurring cost of the first station would be added to the non-recurring development project cost. Some of the major non-recurring tests are delineated in the following table.

**Table 2. Non-recurring Tests**

|     |   |
|-----|---|
| 1.  | System mechanical and electrical design   |
| 2.  | Test head design including cables and mechanical mounting   |
| 3.  | Transition adapter design   |
| 4.  | Self test adapter design  |
| 5.  | Computer hardware configuration and design including migration capabilities for ATS software  |
| 6.  | 960B hardware replacement design  |
| 7.  | CRU emulation software design   |
| 8.  | DMAC emulation software design  |
| 9.  | Design updates for acceptance test procedure and demonstration software   |
| 10. | Ordering prototype equipment and generating a parts list for all the above elements   |
| 11. | Production build and test procedure drawings, and software release including necessary ECNs and Final release after prototype demonstration |

The above elements are representative of the work that would be necessary in order to create the new DDMTS system. However, it should be noted that the list is general in nature and may not include all items that would be required. Further discussions with the U.S. Air Force would be necessary.

#### **4.4.2 RECURRING ELEMENTS**

The recurring elements associated with the creation of a new DDMTS fall into the categories of (1) labor associated with building an actual station and (2) equipment elements that make up the station. All of these were defined in detail in the study report.

## **4.5 CONCLUSION**

The study report, CDRL A007, met all of the goals set forth in paragraph 4.3, above.

## **5.0. SUMMARY**

The viability of the ATS-960 as a general-purpose test system has been clearly shown. Seventeen years after Texas Instruments ceased production of this equipment, a significant number are still in use on major active projects. Among these are the worldwide F16 depots; Telephone Equipment test at GTE and Fujitsu; Gyro Test at British Aerospace; testing of several major missile product lines at British Aerospace; and Toronado Radar testing at GEC, Edinburg and for several European Air Forces. Most of these programs are expected to continue for at least another decade. Additionally, during its existence, the DDMTS has hosted approximately 350 Test Program Sets for both the F16 aircraft and the F16 Avionics Intermediate Shop (AIS). The disk upgrade funded as a part of this subcontract has enhanced the short-term viability of the DDMTS.

Finally, C&H believes that it has the capability to develop the proposed VXI replacement for the DDMTS. It is felt that this capability has been demonstrated through the discussion of prior Technology Insertion Programs given in the VXI Study Report and by the company's prior experiences in the delivery of over 50 custom test systems, most of which were VXI based. Further, C&H holds all technology rights and drawings necessary to accomplish an upgrade to the basic ATS-960 and a staff with the experience to do so.

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